Data Introduction

Deep Impact: Impactor Targeting Sensor (ITS) Data

Instrument Operations

The ITS is a bilateral frame transfer CCD camera with an unfiltered 1024^2-pixel image area. The instrument took scientific data only from the time the Deep Impact Impactor spacecraft (DII) was released from the flyby spacecraft (DIF), a period a bit over 24 hours, so these data are all on days of year (DOY) 184 and 185 (= 2005 July 3 and 4 UTC) with image size decreasing (smaller subframes) as DII neared the comet in order to transmit images more frequently. Some of the later images show significant smear as dust particles hitting DII caused attitude fluctuations. After exposure, each image is rapidly transferred to two storage regions on opposite sides and is then read out in four separate quadrants via separate readout amplifiers. Thus quadrant boundaries are noticeable in the raw data and they are not always completely eliminated in the calibrated data. In addition, the center lines of the image (511 and 512 for 0-based indexing of a full image) have 5/6 the nominal pixel size, due to the fact that both sides of the frame transfer share one of the three clock cycles used to transfer the image. The data are calibrated to units of surface brightness, thus when computing total incident flux or when measuring distances across the center line, the smaller size of the center pixels should be considered. The instrument can be read out in sub-frame modes down to 64^2, always centered on the chip. The data may be compressed on the spacecraft from 14-bit to 8-bit values through a look-up table, and decompressed by the calibration pipeline. Most of the science data were compressed. In the larger format readouts, there are overclock pixels at the edges of the image. The first 128 bytes in one quadrant are overwritten by header information.

Reading the Data

The data are all stored as FITS files with detached PDS labels, one label and one FITS file for each exposure. Filenames are chronologically ordered. The first part of the filename is "iv" (for ITS Vis) followed by the truncated UTC date (YYMMDDHH). The second part of the filename is the sequence number (aka exposure ID) of the image as used in our documentation and in spreadsheets that list the files. The third numerical group is 001 for all files from ITS and is used primarily for the other instruments. For calibrated data, this is followed by a 1- or 2-letter code to indicate type of product – "r" for radiance or "rr" for reversible radiance (I/F images are not provided in the latest version but we provide the multiplicative constant to convert from radiance to I/F). Note that the overclock and image header pixels may include raw values that could affect the calculated minimum and maximum data values. Take care when displaying images with programs that automatically scale to the data minimum and maximum.

Each raw image consists of two data objects. The first data object is the image as an array of 1- or 2-byte integers, while the second (aka FITS extension 1) is a quality factor image (1-byte integers) flagging bad pixels. Each calibrated image product consists of four data objects. The primary image itself (floating point) is in units of radiance, and is followed by an array of quality factors (1-byte integers), an image of signal-to-noise ratio (floating point), and a small array (2 columns) of the applied stripe removal (mitigating an electrical interference pattern). Since destriping was turned off for ITS, this last object is uniformly zero in these datasets. The pixels in the quality factor and signal-to-noise ratio arrays have a one-to-one correspondence to every pixel in the primary image.

If your favorite analysis environment is IDL, you can use the package readpds.pro, which is available at PDS-SBN (http://pdssbn.astro.umd.edu/tools/). If you type "data = readpds(<filename.lbl>)", it will read the data, including all extensions, into an IDL structure containing all the parts of the data product. To see the various pieces, type "help, /struct, data" and it will list the pieces of the highest level of the structure. Some of those will themselves be structures and you can type, "help, /struct, data.piece1" to find out what is in the sub-structure piece1. If your favorite environment is ISIS, there is a routine pds2isis, although we have not exercised this routine.

PDS does not explicitly support FITS, but if your favorite analysis environment is based exclusively on FITS, you can read the FITS file directly (with extension .fit), ignoring the PDS label (the file with .lbl extension), but you need to be aware that PDS does not validate or officially support the FITS standard. We strongly encourage the use of the freely available routine fv (http://heasarc.gsfc.nasa.gov/ftools/fv/) to read the entire file and determine which extensions are of interest.